

AMENDMENTS TO THE SPECIFICATION

Page 1, line 15 to page 2 line 1:

In a waveguide transmission line assembly according to ~~example~~ (1), in a dielectric substrate having two or more conductor layers, two lines of through holes are provided, each line having a plurality of through holes electrically interconnecting the conductor layers, so that the space between the two interconnected conductor layers and the two lines of through holes operate as a waveguide (a dielectric-filled waveguide). In a dielectric waveguide line and a wiring board according to ~~example~~ (2), in addition to the construction described above, conductor sub-layers electrically connected to the through holes are formed between the two main conductor layers, and outside the lines of through holes.

Page 2, line 2 to line 11:

However, in both ~~example~~ (1) and ~~example~~ (2), the through holes arranged in planes which extend in a direction perpendicular to the waveguide (and each hole being arranged perpendicular to the plane of the dielectric substrate), are the only current paths which operate as walls; thus, current concentrates in the through holes, causing resulting in the problem of increased conductor loss. Furthermore, the through holes formed in the direction perpendicular to the plane of the dielectric substrate allow current to flow only in the direction perpendicular to the dielectric substrate, and do not allow current to flow in the diagonal direction, causing resulting in the problem that the transmission characteristics are not as good as in compared to a common waveguide or a dielectric-filled waveguide.

Page 6, line 3 to line 4:

Figs. 6A, and 6B, and 6C are diagrams showing dimensions of each portion and Fig. 6C is an example of transmission characteristics of the transmission line assembly.

Page 6, line 12 to line 13:

Fig. 10A, 10B, 10C and ~~to~~ 10D are sectional views of the dielectric waveguide at different manufacturing steps according to the sixth embodiment.

Page 6, line 20:

DETAILED DESCRIPTION OF EMBODIMENTS OF THE INVENTION

Page 6, line 21 to page 7, line 1:

The construction of a transmission line assembly according to a first embodiment will be described with reference to Figs. 1A and 1B, Figs. 2A and 2B, and Figs. 3A to 3C.

Throughout this specification and drawings, the same element is designed by the same reference numeral unless otherwise indicated.

Page 7, line 2 to line 15:

Fig. 1A is a perspective view of the transmission line assembly, and Fig. 1B is a sectional view thereof. Referring to Figs. 1A and 1B, a dielectric plate 1 has a continuous protruding portion 2, so that a section of the dielectric plate 1 taken perpendicularly to the extending direction of the protruding portion 2 is convex. On both of the surfaces of the dielectric plate 1, including the outer surface (the side surfaces and the top surface) of the protruding portion 2, electrodes 3 (see Fig. 1B) are formed. Furthermore, along the extending direction of the protruding portion 2, a plurality of through holes 4, each electrically interconnecting the electrodes 3 formed on both of the surfaces of the dielectric plate 1, is arrayed on both sides of the protruding portion 2. As shown in Fig. 1B, the width W of the protruding portion 2 is not longer than half the wavelength in the dielectric plate 1 at the operating frequency, and the height H from the bottom surface of the dielectric plate 1 to the top surface of the protruding portion 2 is at least as long as half the wavelength in the dielectric plate 1 at the operating frequency.

Page 7, line 20 to line 24:

According to this construction, as depicted in Figs. 2A, 2B, the plurality of arrayed through holes 4 equivalently forms side walls of a waveguide, so that electromagnetic waves propagate in a mode equivalent to TE₁₀ mode with the two opposing side surfaces of the protruding portion 2 as H planes and the top surface of the protruding portion 2 and the bottom surface of the dielectric plate 1 as E planes.

Page 8, line 22 to line 25:

That is, in order to inhibit transformation to the parallel-plate mode, if the width W (see Fig. 3B) of the protruding portion is half the wavelength, the distance from the side surfaces of the protruding portion to the through holes must be set not longer than a quarter of the wavelength.

Page 9, line 10 to line 21:

Next, the construction of transmission line assemblies according to a second embodiment is shown in Figs. 4A and 4B. As opposed to the first embodiment in which the two lines of through holes opposing each other are arrayed on both sides along the protruding portion formed on the dielectric plate, a plurality of lines of through holes is provided on each side of the protruding portion 2 in the second embodiment. In the example shown in Fig. 4A, two lines of through holes 4 are arrayed in a staggered pattern on each side along the protruding portion 2. In the example shown in Fig. 4B, three lines of through holes 4 are arrayed on each side along the protruding portion 2, also in a staggered pattern. By multiplexing the lines of through holes as described above, radiation of a parallel-plate mode propagating through the dielectric plate from the transmission line to the outside or from the outside to the transmission line can be further suppressed.

Page 10, line 3 to line 8:

Figs. 6A and 6B show specific dimensions of each portion and transmission characteristics of the transmission line. The relative constant of the dielectric plate is 7.0, the radius r of the line center of the bend portion is 2.0 mm, as shown in Fig. 6A, the diameter of the through holes 4 is 0.1 mm, the pitch of the through holes 4 is 0.4 mm, and the dimensions of the other portions are the values shown in Fig. 6B, so that three lines of through holes 4 on each side, i.e., six lines in total, are formed.

Page 11, line 10 to line 13:

Referring to Figs. 9A and 9B and Figs. 10A to 10D, reference number 1 indicates a dielectric substrate, 2 indicates a protruding portion, 3a indicates a bottom-surface electrode, 3b indicates a top-surface electrode, 4 indicate through holes, 101 and 110 indicate dielectric sheets, and 104 indicate perforated holes.

Page 13, line 21 to page 14, line 2:

Then, as shown in Fig. 10D, the top-surface electrode 3b is formed on one of the surfaces of the dielectric substrate 1 including the side surfaces and the top surface of the protruding portion 2, and the bottom-surface electrode 3a is formed on the other surface of the dielectric substrate 1. Furthermore, inner-surface electrodes are formed on the inner surfaces of the perforated holes 104 (see Fig. 10C), whereby the through holes 4 (see Fig. 10D) electrically interconnecting the top-surface electrode 3b and the bottom-surface electrode 3a are formed.

Page 14, line 14 to line 16:

Referring to Figs. 11A and 11B, reference number 1 indicates a dielectric substrate, 2 indicates a protruding portion, 3a indicates a bottom-surface electrode, 3b indicates a top-surface electrode, and 4 indicate through holes.

Page 15, line 13 to line 19:

Fig. 12 is a perspective view of a dielectric plate 1 seen from the side on which electronic components are mounted, and Fig. 13 is an equivalent circuit diagram of the radar apparatus. The dielectric plate 1 has continuous protruding portions (not shown) on the bottom side thereof as viewed in the figure Fig. 12 so as to have a convex cross-section. Furthermore, electrodes are formed on both of the surfaces of the dielectric plate 1, and a plurality of through holes 4 is arrayed on both sides along the protruding portions, whereby transmission lines are formed.

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Although the protruding portion is not apparent in Fig. 12, which shows the side on which electronic components are mounted, the layout of the transmission lines can be recognized from the array pattern of the through holes 4. That is, broadly, five transmission lines indicated by G1, G2, G3, G4, and G5 are formed.

Page 15, line 24 to page 16, line 17:

On the top surface of the dielectric plate 1 as viewed in the figure Fig. 12, a voltage-controlled oscillator (VCO) is connected to a coplanar line 10. The coplanar line 10 is coupled to the transmission line indicated by G1. Between the transmission lines G1 and G2, an amplifier circuit (AMP) implemented by an FET is provided. Furthermore, at an end of the transmission line G3, a slot antenna is formed, so that a transmission signal is radiated from the slot antenna in the direction perpendicular to the dielectric plate 1. The adjacent portions of the transmission lines G2 and G5 constitute a directional coupler. A signal which is distributed by the directional coupler is coupled as a local signal to a coplanar line 12 which is connected to one of the diodes of a mixer circuit. Furthermore, a

circulator is formed at the Y-branched center of the transmission lines G2, G3, and G4.

The circulator is constructed of a resonator implemented by a disk-shaped ferrite plate and a permanent magnet applying a static magnetic field to the ferrite plate in the perpendicular direction, which are not shown in Figs. 9A and 9B. Via the circulator, a reception signal from the slot antenna is coupled to a coplanar line 14 which is connected to the other diode of the mixer circuit. The two diodes of the mixer circuit operate as a balanced mixer circuit, and the output thereof is fed to an external circuit via a balanced line 16 having matching passive components in the middle.